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Enhancing Concrete Properties Using Sugarcane Bagasse Ash and Crushed Groundnut Shells as Partial Replacements for Cement and Fine Aggregate

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Abstract: ***This study investigates the potential use of Sugarcane Bagasse Ash (SCBA) as a partial replacement for cement and Crushed Groundnut Shells (CGS) as a partial replacement for fine aggregates in M25 grade concrete. The research aims to mitigate environmental issues posed by agricultural waste while promoting sustainable construction practices. A comprehensive experimental program was conducted with variations in SCBA (2%, 5%, and 10%) and a fixed 5% replacement of sand with CGS. Concrete properties were evaluated through slump tests and compressive strength tests at curing intervals of 7, 14, and 28 days. Results show that up to 10% SCBA and 5% CGS can effectively be used without compromising structural performance. The use of agricultural by-products presents a viable solution for eco-friendly and cost-effective construction materials.***
Keywords: Concrete, Sugarcane Bagasse Ash, Crushed Groundnut Shells, M25 Grade, Sustainable Construction, Compressive Strength.

I. INTRODUCTION

Concrete remains the most consumed construction material globally, with cement and sand as its primary components. However, their extensive use leads to CO2 emissions and depletion of natural resources. The construction industry is thus exploring alternative materials to reduce environmental impacts. Agricultural waste such as Sugarcane Bagasse Ash (SCBA) and Crushed Groundnut Shells (CGS) offer promise due to their availability and pozzolanic properties. This study focuses on using SCBA as a cement replacement and CGS as a partial sand substitute in M25 concrete, aiming to enhance sustainability in the construction sector.

II. MATERIALS AND METHODS

A. Materials Used

- Cement: PPC 43 grade cement
- Fine Aggregate: Zone I river sand
- Coarse Aggregate: 20 mm crushed angular stone
- SCBA: Collected from Warana Sugar Factory
- CGS: Obtained locally and crushed manually
- Water: Potable tap water used

B. Mix Design

The M25 mix design was developed using IS 10262:2009. SCBA was used to replace cement at 2%, 5%, and 10%, while CGS replaced sand at 5%. ADDMIX 210 superplasticizer was included in some mixes to enhance workability.

C. Testing Procedure

- Slump Test: To assess workability
- Compressive Strength Test: Conducted on 150 mm cubes at 7, 14, and 28 days
- Sieve Analysis and Specific Gravity Tests were conducted to classify materials.

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III. EXPERIMENTAL RESULTS AND DISCUSSION

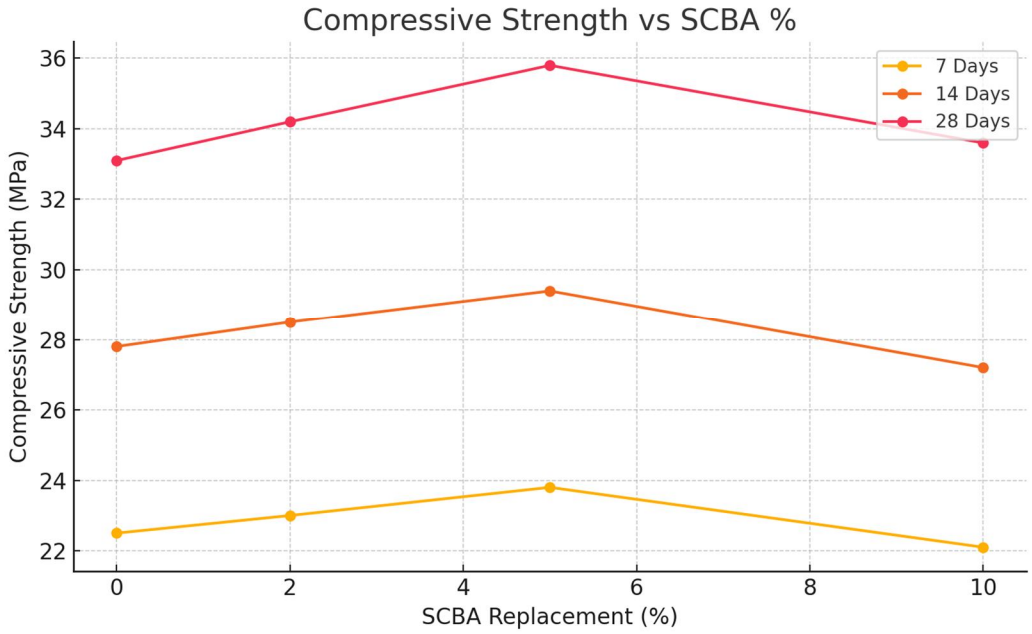
A. *Slump Test Results*

A consistent slump of around 50 mm was observed for most mixes, indicating medium workability.

B. *Compressive Strength Results*

SCBA %	7 Days (MPa)	14 Days (MPa)	28 Days (MPa)
0	22.5	27.8	33.1
2	23.0	28.5	34.2
5	23.8	29.4	35.8
10	22.1	27.2	33.6

Figure 1. Compressive Strength vs. Curing Days for Various SCBA Levels



The compressive strength peaked at 5% SCBA with 5% CGS, indicating an optimal blend. Higher SCBA levels showed slight reductions, possibly due to increased porosity.

C. *Cost and Sustainability Analysis*

SCBA and CGS are virtually cost-free waste products. Their use can significantly reduce construction costs and environmental pollution, aligning with sustainable development goals.

IV. CONCLUSION

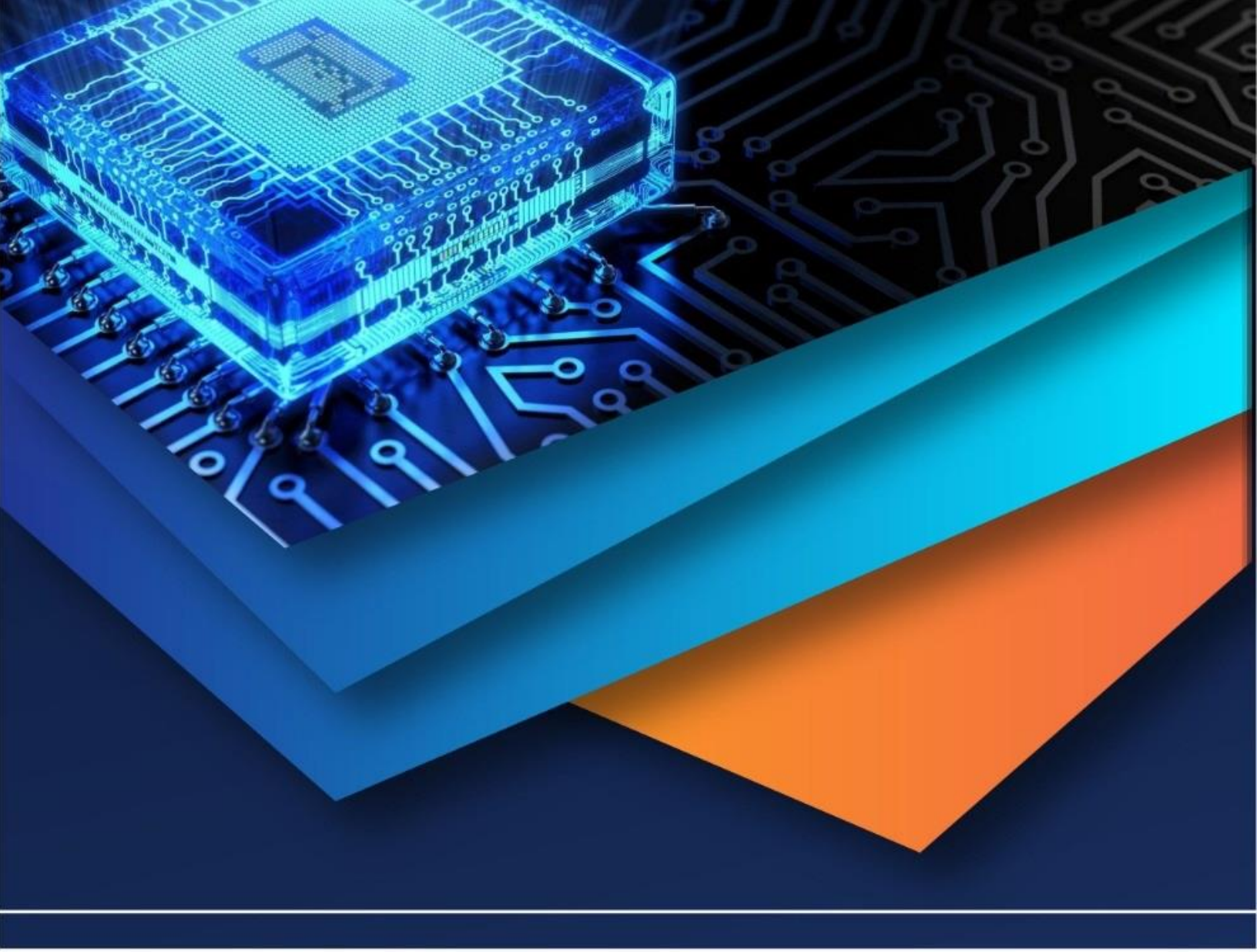
The incorporation of 5% Sugarcane Bagasse Ash and 5% Crushed Groundnut Shells in M25 concrete provides optimal compressive strength and workability. This approach supports waste utilization, reduces reliance on non-renewable resources, and offers economic advantages. Future research can explore durability parameters and field performance.

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